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CATALYST FOR BREAKING DOWN OZONE
[KATALYSATOR ZUM SPALTEN VON OZON]

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The invention relates to a catalyst for breaking down ozone. /2*

Ozone is a strong oxidizing compound and therefore represents a health risk for humans depending on its concentration in the air. Thus in Germany, the maximum permissible concentration value for ozone in the workplace (MAK) is specified as 0.1 ppm, corresponding to 200 $\mu g/m^3$.

Ozone can be generated in industrial systems, but also in office machines (photocopiers, laser printers) and for the purpose of germ elimination (e.g. in indoor swimming pools and medical surgery theaters), also in congested areas in the open air in the presence of air pollutants in combination with sunshine.

The ozone concentration in air can be reduced by thermal, adsorptive or catalytic methods.

JP 1-127 040 and JP 63-126 525 describe methods for eliminating ozone from gas mixtures in which the gas mixture is passed over a catalyst of activated charcoal and manganese oxide to convert ozone into oxygen. One variation of this method is described in JP 59-42 023, in which instead of manganese oxide, iron hydroxide or iron oxide hydrate is used. The activated charcoal adsorbs ozone and the manganese oxide or the iron hydroxide accelerates the decomposition of ozone catalytically. What is disadvantageous in this process is that the activated charcoal not only adsorbed ozone, but also other air pollutants, e.g. nitrogen oxides and therefore quickly becomes deactivated due to the adsorption of the other air pollutants. The use of manganese oxide and iron hydroxide has the disadvantage that these substances have a relatively low catalytic

*Numbers in the margin indicate pagination in the foreign text.

activity so that large quantities of them are necessary since the catalyst that has air to be inhaled release traces of the catalytically active substance into the air. However, heavy metal immisions are also undesirable.

Providing a heated platinum catalyst that converts the nitrogen oxide into nitrogen and oxygen before an ozone filter of activated charcoal and/or manganese and thereby reducing the adsorption of nitrogen oxides on the activated charcoal so these can bind more ozone is known from DE-40 41 088 C2.

What is disadvantageous here is that a heated catalyst is needed for this and that according to regulations a lot of space is needed for the activated charcoal filter so it is difficult to provide such an arrangement in compact devices.

Reducing the ozone content in the passenger compartments of high-flying airplanes in that the air containing ozone is passed over a metal catalyst, in which a heated monolytic element is involved, is known from DE-O 30 29 948. Such an element also requires a lot of space for its installation.

The present invention is based on the object of providing an economical catalyst for breaking down ozone that can be installed without difficulty in air conditioners, ventilation systems and automobiles and also causes a significant reduction in the ozone content in the inhaled air.

This object is achieved by a catalyst with the characteristics specified in Claim 1. Advantageous further developments of the invention

are the object of the subclaims.

According to the invention, a net-shaped catalyst is used that is coated with noble metal and is operated at normal ambient temperature, meaning it is not heated.

This has the following advantages:

- A net is a two-dimensional structure and can be installed in a space-saving manner even in systems and devices that are already present, e.g. in ventilation ducts to the passenger compartment of automobiles that are present, at the outflow side of air conditioners and ventilation systems, and also in devices and machines like photocopiers that generate ozone, preferably before the outlet of air that is conducted through the device and/or the machine by a fan. The two-dimensional net itself requires only minimum space and can be adapted to any flow cross section. Significant changes to devices, machines or automobiles are not necessary for its use.

- Nets can have very fine mesh. The smaller the mesh width, the greater the effective catalyst surface and the greater the conversion rate of the catalyst. The mesh width is limited downward only by the costs that have to be spent for manufacturing it and by the pressure loss that has to be taken into account.

- Since nets are very thin, several nets can also be combined to a layered catalyst without reaching a thickness that is too great. However, advantageous results (great reduction of the ozone content) can already be achieved with a single-layer catalyst net; the conversion rate can be increased by the use of a second or third layer. More than two, or

at the most three, layers are not recommended.

- The catalyst uses a noble metal, especially platinum or palladium, as the catalytically active material. In this way, a significantly higher catalytic activity is already achieved at a lower temperature, which /3 means that compared to non-noble metal catalysts like those based on manganese oxide, it is possible to use the smallest quantities of catalytically active metal. This makes the catalyst cost-effective and also reduces the quantities of catalytically active substance that can leave the catalyst with the air that will be inhaled.

- Because of the use of noble metal, especially platinum or palladium, as catalytically effective substance, there are already definite reductions of the ozone content in inhaled air at normal ambient temperature and with a single-layer net.

- The catalyst does not need to be heated.

- A net is a conceivably simple and cost-effective substrate.

- A net can also be curved in almost any way and in this way be adapted to its usage location.

Wire nets that are coated in a known way first with a wash-coat method with an aluminum oxide layer to increase the effective surface before they are impregnated with a noble metal solution and/or calcined are especially suitable as nets. Another option for anchoring the noble metal on a wire net consists of taking a steel containing aluminum for the wire net and annealing the net in air, whereby in a surface layer the aluminum is converted into aluminum oxide on which the noble metal can be anchored.

However instead of a net, a fine-mesh expanded metal can also be

used. That will be included in the patent claims.

Instead of a wire net, a plastic net can also be used. The catalytically active noble metal can be anchored on the plastic net using methods that are known for metallizing plastics, especially coating in chemical metallizing baths, coating using chemical deposition from the vapor phase (CVD method) or coating using physical deposition from the gas phase (PVD method) or by dusting in a vacuum chamber.

The smaller the mesh width, the greater the conversion rate of the catalyst. The mesh width is effectively less than 2 mm, preferably less than 1 mm and if the pressure loss that occurs allows this, less than 0.5 mm. Networks with the fineness of window screen can be used for the purposes of the invention.

In front of the net, which is coated with a catalytically active noble metal at a specific distance, preferably a distance between 1 and 3 mm and best at a distance between 1 and 2 mm, another net is arranged that is preferably not coated with noble metal. A net such as this arranged in front can considerably increase the effectiveness of the catalyst although it is not catalytically active itself. Arrangement "before" the catalytically active net means that the air first passes through the net that is not catalytically active and then through the catalytically active net.

Example:

1. Air with an ozone content of 0.5 to 1 ppm flows through a catalyst of an expanded metal, made of steel no. 1.4842 with mesh having mesh width lying between 0.2 and 1.5 mm as a catalyst substrate and with platinum

as a catalytically active coating. At room temperature and an air throughput of 50 l per hour and cm2 catalyst surface, there was an ozone reduction by 83%, and by 38% with a throughput of 100 l per hour and cm2 catalyst surface.

2. As a modification of the first example, two such expanded metals coated with platinum are arranged at a distance of 1.5 mm so that they cover each other. In this case, under the same conditions as above and with an air throughput of 50 l per hour and cm2, the ozone reduction increased to 92%, with a throughput of 100 l per hour and per cm2 to 58%.

3. As a modification of this example, the expanded metal coated with platinum has an uncoated expanded metal that is uncoated arranged 1.5 mm in front of it. In this case, under conditions that are otherwise the same, the ozone reduction with an air throughput of 100 l per hour and cm2 is about 67%. Under the same conditions, the ozone reduction increased to 76% if another expanded metal coated with platinum is arranged after them at a distance of 1.5 mm. The arrangement at the back of a third expanded metal coated with platinum practically no longer increases the ozone reduction.

The catalyst according to the invention produces an ozone reduction not only at normal ambient temperature (20°C) but also with a somewhat lower activity at 0°C. Heating of the catalyst can be dispensed with.

Claims

1. Catalyst consisting of a net-shaped substrate that is coated with a noble metal for use as unheated catalyst for breaking down ozone.

2. Catalyst according to Claim 1, characterized in that the net /4

is a wire net.

3. Catalyst according to Claim 1, characterized in that the net is a plastic net.

4. Catalyst according to one of the preceding claims, characterized in that the mesh width of the net is less than 2 mm.

5. Catalyst according to one of Claims 1 to 3, characterized in that the mesh width of the net is less than 1 mm.

6. Catalyst according to one of Claims 1 to 3, characterized in that the mesh width of the net is less than 0.5 mm.

7. Catalyst according to Claim 2, characterized in that the net is coated with Al_2O_3 on which the noble metal is anchored.

8. Catalyst according to Claim 2, characterized in that the net consists of steel containing aluminum that is oxidized on the surface.

9. Catalyst according to Claim 3, characterized in that the net is coated by wet chemical deposition, by chemical vapor deposition (CVD) or by physical vapor deposition (PVD) or by dusting with noble metal.

10. Catalyst according to one of the preceding claims, characterized in that platinum or palladium is provided as the noble metal.

11. Catalyst according to one of the preceding claims, characterized in that another net is arranged in front of the net and at a distance from it.

12. Catalyst according to Claim 11, characterized in that the other net is not coated with noble metal.

13. Catalyst according to Claim 11 or 12, characterized in that the distance between the nets is between 1 and 3 mm and preferably between

1 and 2 mm.

14. Catalyst according to Claim 11, 12 or 13, characterized in that two nets coated with noble metal are arranged so that they cover each other, whereby in front of this arrangement another net that is preferably not coated with noble metal.

15. Use of an unheated catalyst made of a net-shaped substrate that is coated with noble metal to break down ozone that is contained in air that flows through the catalyst.